

$H \rightarrow WW$ and ZH in di-lepton mode with 1fb^{-1}

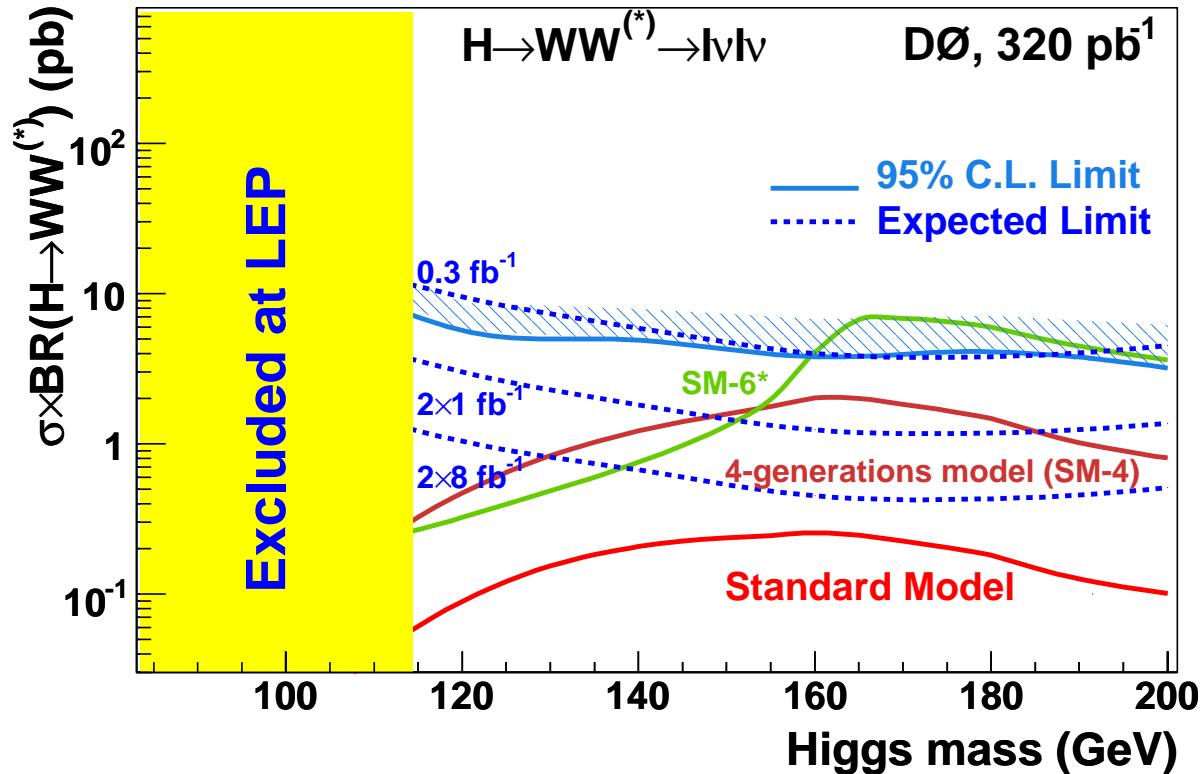
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$H \rightarrow WW^{(*)}$ analysis

- Analysis by Johannes Elmsheuser, Marc Hohlfeld, and Maxim Titov.
- Three channels: ee , $e\mu$, $\mu\mu$.
- Current analysis is based on 300-325 pb⁻¹ pass2 data (up to V12 trigger).
- PRL draft is under EB005 review.
- Maxim is working on V13 data, will move to p17 soon.

$H \rightarrow WW^{(*)}$ results and future exclusion



Limits for $\sigma \times BR(H \rightarrow WW^{(*)})$ (pb)

| M_H [GeV] | 100 | 120 | 140 | 160 | 180 | 200 |
|---------------------|------|-----|-----|-----|-----|-----|
| expected limit [pb] | 20.1 | 9.5 | 5.9 | 4.0 | 3.8 | 4.5 |
| observed limit [pb] | 19.2 | 5.7 | 4.9 | 3.8 | 4.1 | 3.2 |

Comparison of $H \rightarrow WW$ results with HWG report

| | Current Analysis | HWG report | Same cuts as in HWG now |
|---|------------------|--------------|-------------------------|
| L = 1 (fb⁻¹) H(160) \rightarrow WW \rightarrow ee | | | |
| Signal events (S) | 0.635 | 0.325 | 0.24 |
| Background evts (B) | 16.8 (10.4 WW) | 1.1 (1.0 WW) | 2.5 (1.6 WW) |
| S/B | 0.16 | 0.31 | 0.15 |
| L = 1 (fb⁻¹) H(160) \rightarrow WW \rightarrow emu | | | |
| Signal events (S) | 1.17 | 0.65 | 0.42 |
| Background evts (B) | 22.3 (16.3 WW) | 2.2 (2.0 WW) | 3.8 (2.7 WW) |
| S/B | 0.24 | 0.44 | 0.215 |

Using same cuts (no likelihood) as in Tevatron HWG study now:

- Smaller selection efficiency for $H \rightarrow WW \rightarrow ll$ (HWG report assumes higher EM-id efficiency and improved muon resolution);
- Larger WW background and tt background contribution;
- Only W +jet background was considered in HWG (no W+ γ bkg).

$H \rightarrow WW^{(*)}$ analysis for 1fb^{-1}

Current predictions for $H \rightarrow WW$ upper limits (1fb^{-1}) are worse than in HWG report;

- Most important backgrounds are:
 - $W + \gamma/\text{jet}$ (for low Higgs masses) and
 - WW production (for High Higgs masses);
- $W + \gamma/\text{jet}$ background (dominant statistical uncertainty):
 - Out of 4.5 Million events only 150 events survive initial preselection and 1-10 events final cuts \rightarrow more MC is needed;
 - Conversion probability is not properly modeled in MC
better detector description (p17 ?)
 - ISR- $W\gamma$ graphs are not included in the current pythia W inclusive sample;
- WW background (WW x-section + JES are dominant systematical uncertainty):
 - Theoretical uncertainty on WW production cross section
 - $\sim 10\%$ WW cross section difference between CTEQ5L and CTEQ6L

$H \rightarrow WW$ analysis for 1fb^{-1}

- Improvements for the $H \rightarrow WW$ analysis are expected from:
 - Use of ‘advanced analysis techniques’, based on event probabilities, instead of cut-based method;
 - Improved lepton identification efficiencies and better muon resolution;
 - Better understanding of background contribution and suppression (e.g. WW , $W\gamma$)
 - better exclusion limits

ZH search in ee channel

- Analysis by James Heinmiller, Nikos Varelas.
- Plan for the analysis:
 - Measure $Z+b$ jet cross section
 - Compare $Z+b/Z+j$ measurements
 - Measure $Z+b\bar{b}$ cross section (limit)
 - Look at ZH cross section limit

Z Inv Mass and pT

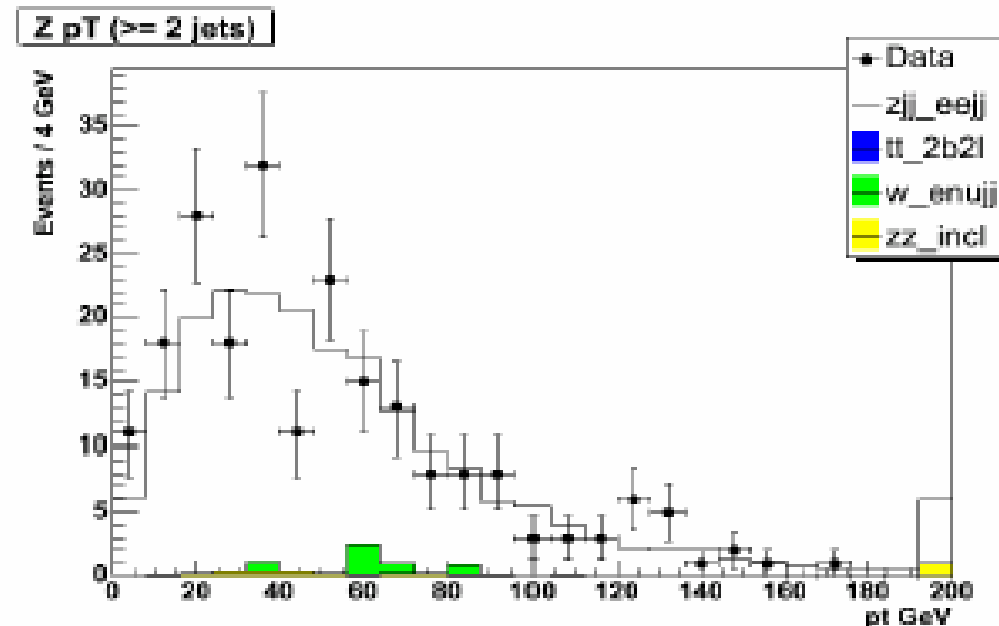
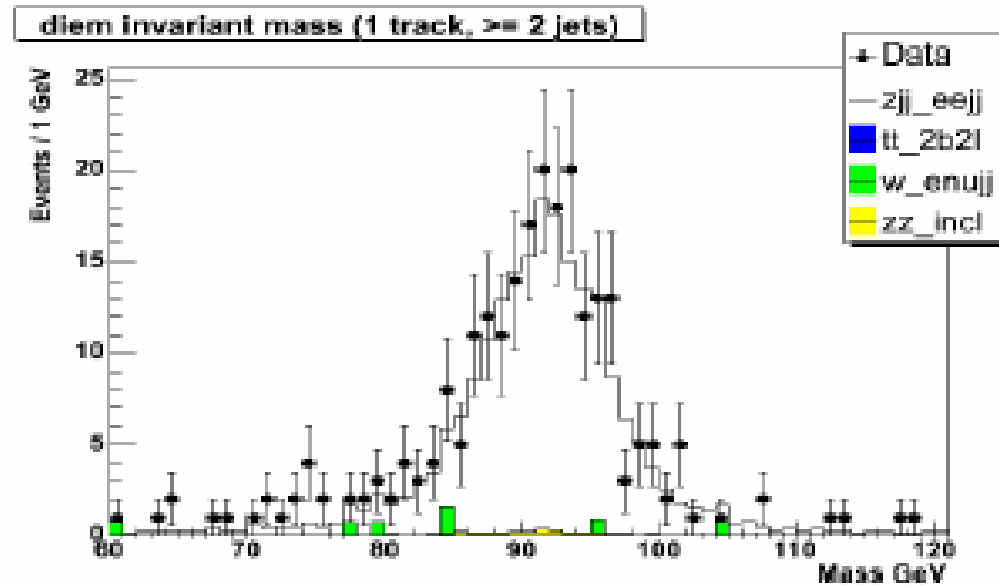
2 electrons

$p_{T^e} > 25 \text{ GeV}$

2 Jets

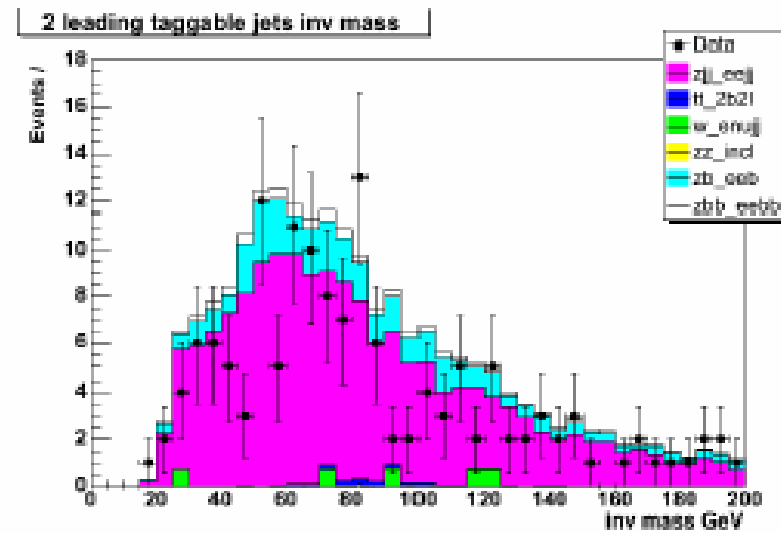
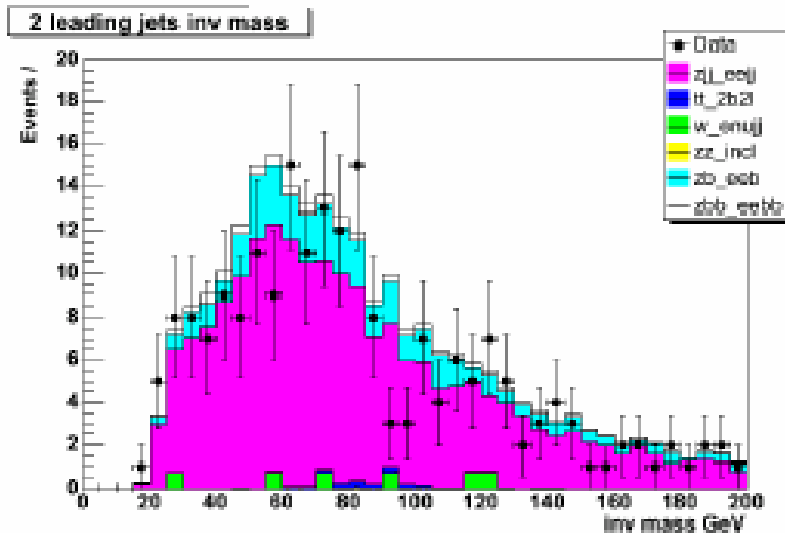
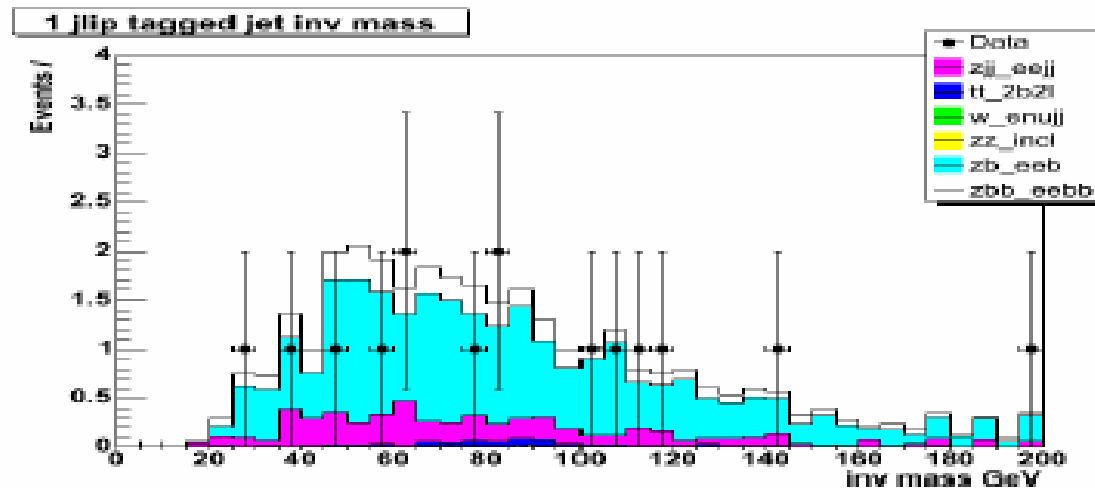
$E_T > 20 \text{ GeV}$

$75 < m_{ee} < 105$



$Z(\rightarrow ee)+2\text{jets}$ with b-tagging

2 leading jets Invariant Mass



Area for improvements

- add the likelihood cut for electron
- expand electron from CC only to EC

| Electrons | Z+ N jets | Z+ 2 jets | Z+2 taggable | Z+1 jlip 4% | Z+2jlip 4% |
|-----------|-----------|-----------|--------------|-------------|------------|
| CC only | 13907 | 219 | 156 | 27 | 2 |
| CC+EC | 26973 | 379 | 269 | 45 | 3 |
| Increase | 1.94 | 1.73 | 1.72 | 1.67 | 1.5 |

- tested on ZH (125 GeV) and $Zjj \rightarrow eejj$
 - CC only: $S/\sqrt{B}=9.8$
 - CCCC and CCEC: $S/\sqrt{B}=10.37$

ZH in ee channel with 1fb^{-1}

- Pass 2 data sample:
 - Lumi Delivered: 533 pb^{-1}
 - Lumi Recorded: 406 pb^{-1} 76.2% of delivered
 - Lumi in analysis: 343pb^{-1} 64.3% of delivered
- Extrapolated to Oct. 2005 shutdown:
(Assuming an average of 85% of quality factor for recorded luminosity)
 - Lumi Recorded: 1 fb^{-1}
 - Lumi in analysis: $\sim 845\text{ pb}^{-1}$

$Z(\rightarrow ee)H$ search for 1fb^{-1}

Things needed to move to p17:

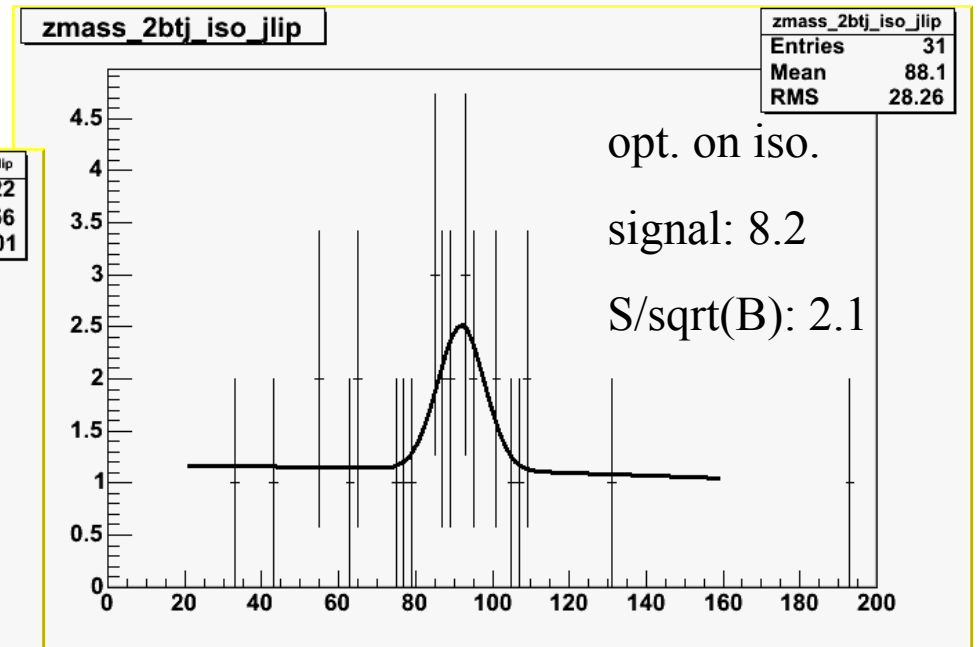
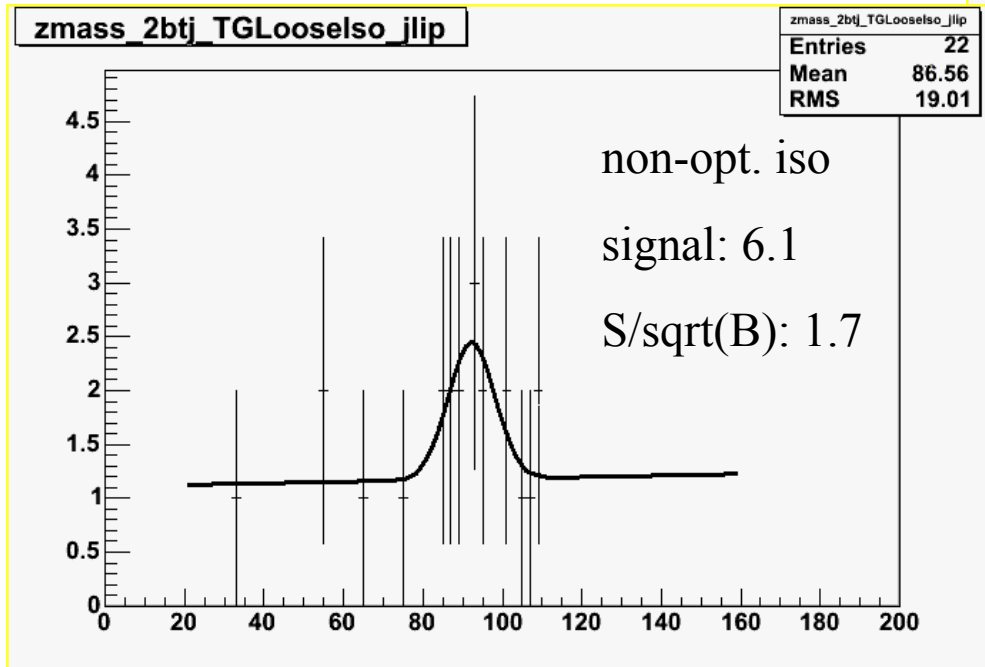
- p17 Monte Carlo
- certified JES for p17
- certified JES for b tagged jets
- certified b-id for p17
- jet resolutions in data and MC for cone 0.5
- jet reco efficiencies
- EM resolutions
- EM-ID efficiencies
- electron trigger efficiency per list
- track matching efficiencies

ZH search in $\mu\mu$ channel

- Analysis by Yildirim, Huishi Dong
- Plan for the analysis:
 - Measure $Z(->\mu\mu)+b\bar{b}$ cross section or set limit
 - ZH sensitivity – set cross section limit
 - Update $\sigma(Z+b)/\sigma(Z+j)$ ratio
 - Measure $Z(->\mu\mu)+b$ cross section

$Z(\rightarrow \mu\mu)bb$

- current study on improvements
 - use x-loose JLIP tag
 - optimize μ isolation



if use loose JLIP, 0 event.

Z_b/Z_j expectation with 1fb^{-1}

- Gain in signal:
 - x2.4 from using extra loose JLIP b-tag & Opt. on di-b
 - x1.5 from μ topological optimization
 - x5 more data
- Reduce uncertainties:
 - statistical error ($0.44 \rightarrow 0.13$)
 - better JES uncertainty
 - better JLIP b-tag uncertainty
 - Mistag rate function uncertainty

Zbb and Zb expectations with 1fb^{-1}

- Zbb cross section:
 - di-muon optimization: using signal significance to get optimized cut point, gain \sim factor of 1.5
 - b-tag: JES v5.3 JLIP, try other b-tag method
 - need continuous JLIP b-tag working points
 - interpolate the TRF's [Xtight, Xloose]
 - JES??
- Zb cross section:
 - with 1fb^{-1} , we will be able to measure Zb x-section.
 - using same optimization as in Zbb study ,
 - S/\sqrt{B} improve from 6.1 \rightarrow 8.4

Zbb, Zb and ZH in $\mu\mu$ with 1fb^{-1}

- Time scale for Zbb:
 - Currently p14 for summer conference, by July(?).
 - p17 analysis package (CAF based) ready by Sept.
 - small data sample for develop code, July-Sept.
 - large data sample and MC sample, Sept.-Dec.
 - Note ready by mid Dec.
- new Zb/Zj and $\sigma(\text{Zb})$ study begins in 2006.
- Higgs search (ZH) in 2006.